

E 1.28 SOLAR / 1040-79 / 02

Revised 12/19/85

SOLAR/1040-79/02

Monthly Performance Report

SADDLE HILL TRUST

LOT 77

FEBRUARY 1979



U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

SADDLE HILL TRUST
LOT 77

FEBRUARY 1979

I. SYSTEM DESCRIPTION

Saddle Hill Trust Lot 77 is a single-family residence in Medway, Massachusetts. Solar energy is used for preheating incoming city water. The system has an array of flat-plate collectors with a gross area of 78 square feet. The array faces south at an angle of 38 degrees to the horizontal. Air is used as the medium for delivering solar energy from the collector array to an air-to-liquid heat exchanger located in the collector air duct. Water is the medium used to transport solar energy from the heat exchanger to storage. Solar energy is stored in the basement in a 120-gallon preheat storage tank. This preheated city water is supplied, on demand, to a conventional 40-gallon domestic-hot-water (DHW) tank. When solar energy is insufficient to satisfy the hot water requirements, the gas-driven DHW heater provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has two modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when the difference between the temperature of the collector air and the temperature of the water in the preheat tank exceeds 40°F and the temperature of the water in the tank is below 140°F. Both the fan and pump go on. This mode continues until the temperature difference drops to 20°F.

Mode 2 - Storage-to-Space Heating: This mode activates when there is a demand for hot water. Hot water from the top of the preheat tank is transferred to the DHW tank to replace water removed. Simultaneously, city water is automatically supplied to the preheat tank.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was occupied in February and the solar energy system operated continuously during the month. Solar energy satisfied 29 percent of the DHW requirements. The solar energy system provided a fossil fuel energy savings of 0.83 million Btu and incurred an electrical energy expense of 0.089 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 2.9 million Btu for a daily average of 1318 Btu per square foot. This was above the estimated average daily solar radiation for this geographical area during February of 1028 Btu per square foot for a south-facing plane with a

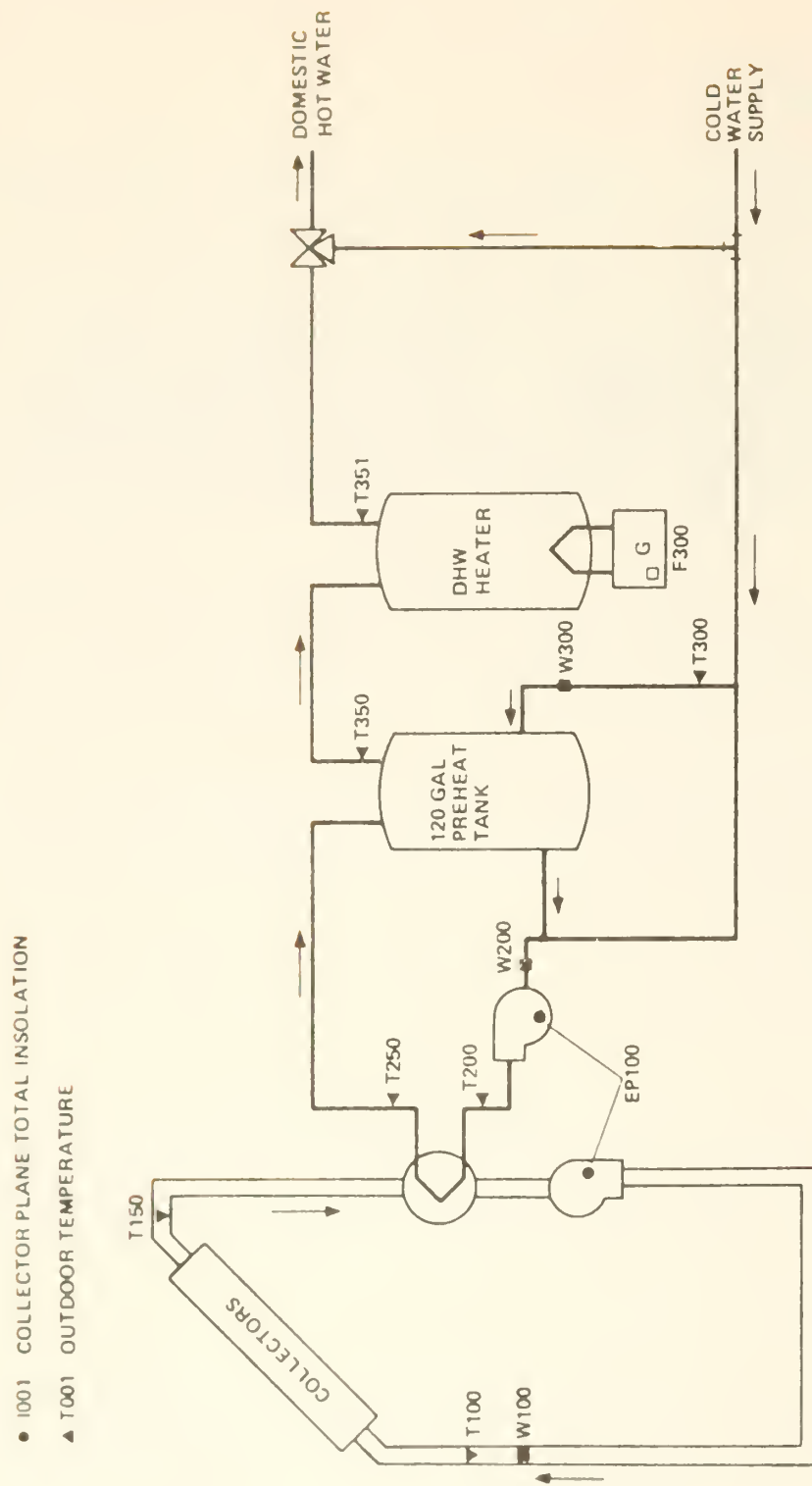


Figure 1. SADDLE HILL TRUST, LOT NO. 77, SOLAR ENERGY SYSTEM SCHEMATIC

tilt of 38 degrees to the horizontal. The average ambient temperature during February was 20°F as compared with the long-term average for February of 30°F.

THERMAL PERFORMANCE

System - During February the solar energy system performed approximately as expected. The expected performance was determined from a modified f-chart analysis using measured weather and load as inputs. Solar energy collected was 0.73 million Btu versus an estimated 0.68 million Btu. Solar energy used by the system was estimated by assuming that all energy collected would be applied to the load. Actual solar energy used was 0.60 million Btu. System total solar fraction was 29 percent versus an estimated 26 percent.

Collector - The total incident solar radiation on the collector array for the month of February was 2.9 million Btu. During the period the collector loop was operating the total insolation amounted to 2.4 million Btu. The total collected solar energy for the month of February was 0.73 million Btu, resulting in a collector array efficiency of 25 percent, based on total incident insolation. Operating energy required by the collector loop was 0.089 million Btu.

DHW Load - The DHW subsystem consumed 0.60 million Btu of solar energy and 3.3 million Btu of auxiliary fossil fuel energy to satisfy a hot water load of 2.0 million Btu. The solar fraction of this load was 29 percent. Losses from the DHW subsystem were 0.57 million Btu. A daily average of 91 gallons of DHW was consumed at an average temperature of 144°F delivered from the tank.

OBSERVATIONS

The 0.57 million Btu loss from the DHW subsystem was at least partly attributed to maintaining a relatively high average temperature of 144°F at the DHW outlet.

ENERGY SAVINGS

The solar energy system provided a fossil fuel energy savings of 0.83 million Btu, while incurring an electrical energy expense of 0.089 million Btu.

III. ACTION STATUS

No action is required at this time.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053 SOLAR/1039-79/02
REPORT PERIOD: FEBRUARY, 1979

SITE/SYSTEM DESCRIPTION:

THE SADDLE HILL TRUST, LOT 77, SOLAR SYSTEM PROVIDES YEAR ROUND HOT WATER TO A SINGLE FAMILY DETACHED HOUSE. THE COLLECTOR IS A SOLARON 2000 FOUR PANEL AIR COLLECTOR. STORAGE IS A 120 GALLON WATER TANK. AUXILIARY HOT WATER IS PROVIDED BY A GAS DOMESTIC HOT WATER HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSO SOLAR CONVERSION EFFICIENCY
ECSO OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

2.878 MILLION BTU
36903 BTU/SG.FT.
0.727 MILLION BTU
9325 BTU/SG.FT.
20 DEGREES F
N.A. DEGREES F
0.21
0.089 MILLION BTU
0.089 MILLION BTU
4.111 MILLION BTU

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENERGY
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HOT WATER
2.004
29
0.600
N.A.
1.977
N.A.
3.295
-0.089
0.830

HEATING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
2.005 MILLION BTU
29 PERCENT
0.600 MILLION BTU
0.089 MILLION BTU
1.977 MILLION BTU
N.A. MILLION BTU
3.295 MILLION BTU
-0.089 MILLION BTU
0.830 MILLION BTU

SYSTEM PERFORMANCE FACTOR:

0.558

* DENOTES UNAVAILABLE DATA

& DENOTES NULL DATA

N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: FEBRUARY, 1979

SCLAR/1039-79/02

SITE/SYSTEM DESCRIPTION:

THE SADDLE HILL TRUST, LOT 77, SOLAR SYSTEM PROVIDES YEAR ROUND HOT WATER TO A SINGLE FAMILY DETACHED HOUSE. THE COLLECTOR IS A SCLARON 2000 FOUR PANEL AIR COLLECTOR. STORAGE IS A 120 GALLON WATER TANK. AUXILIARY HOT WATER IS PROVIDED BY A GAS DOMESTIC HOT WATER HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECSS SOLAR CONVERSION EFFICIENCY
ECSS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

3.037 GIGA JOULES
419076 KJ/SQ.M.
0.767 GIGA JOULES
105802 KJ/SQ.M.
-6 DEGREES C
N.A. DEGREES C
C.21
0.094 GIGA JOULES
0.094 GIGA JOULES
4.338 GIGA JOULES

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION
SOLAR ENERGY USED
OPERATING ENERGY
AUX. THERMAL ENG
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HOT WATER
2.114
29
0.633
N.A.
2.086
N.A.
3.476
-0.094
0.876

HEATING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

COOLING
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.
N.A.

SYSTEM TOTAL
2.115 GIGA JOULES
20 PERCENT
0.633 GIGA JOULES
0.094 GIGA JOULES
2.086 GIGA JOULES
N.A. GIGA JOULES
3.476 GIGA JOULES
-0.094 GIGA JOULES
0.876 GIGA JOULES

SYSTEM PERFORMANCE FACTOR:

0.558

* DENOTES UNAVAILABLE DATA
? DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SCLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENERGY COLLECTION AND STORAGE SUBSYSTEM (FCSS)

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
REPORT PERIOD: FEBRUARY, 1979

SCLAR/1039-79/02

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TC LOADS MILLION BTU	AUX THERMAL TO FCSS MILLION BTU	FCSS OPERATING ENERGY MILLION BTU	FCSS ENERGY REJECTED MILLION BTU	FCSS SOLAR CONVERSION EFFICIENCY
1	0.034	23	0.000	NOT	0.000	NOT	0.009
2	0.118	22	0.033	NOT	0.004	NOT	0.277
3	0.147	24	0.032	NOT	0.005	NOT	0.215
4	0.143	25	0.033	NOT	0.005	NOT	0.233
5	0.117	19	0.021	APPL	0.004	APPL	0.181
6	0.153	16	0.031	APPL	0.005	APPL	0.200
7	0.021	19	0.000	APPL	0.000	APPL	0.000
8	0.085	23	0.010	APPL	0.002	APPL	0.114
9	0.145	13	0.034	APPL	0.005	APPL	0.235
10	0.159	5	0.031	APPL	0.005	APPL	0.194
11	0.162	2	0.023	APPL	0.005	APPL	0.142
12	0.137	5	0.028	APPL	0.005	APPL	0.202
13	0.153	6	0.030	APPL	0.005	APPL	0.196
14	0.162	3	0.029	APPL	0.005	APPL	0.176
15	0.162	12	0.026	APPL	0.005	APPL	0.163
16	0.066	12	0.011	APPL	0.002	APPL	0.166
17	0.168	4	0.038	APPL	0.005	APPL	0.226
18	0.133	8	0.030	APPL	0.004	APPL	0.226
19	0.021	13	0.000	APPL	0.000	APPL	0.000
20	0.158	26	0.049	APPL	0.006	APPL	0.309
21	0.069	37	0.018	APPL	0.003	APPL	0.266
22	0.128	42	0.040	APPL	0.005	APPL	0.317
23	0.029	34	0.002	APPL	0.001	APPL	0.061
24	0.004	36	0.000	APPL	0.000	APPL	0.000
25	0.006	37	0.000	APPL	0.000	APPL	0.000
26	0.004	32	0.000	APPL	0.000	APPL	0.000
27	0.023	33	0.000	APPL	0.000	APPL	0.000
28	0.173	37	0.052	APPL	0.006	APPL	0.300
SUM	2.878	-	0.600	N.A.	0.089	N.A.	-
AVG	0.103	20	0.021	N.A.	0.003	N.A.	0.208
NRS ID	0001	N113			G102		N111

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT COLLECTOR ARRAY PERFORMANCE

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02052 SOLAR/1039-75/02
REPORT PERIOD: FEBRUARY, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.034	0.001	0.000	24	0.013
2	0.118	0.105	0.038	26	0.322
3	0.147	0.134	0.040	30	0.270
4	0.143	0.131	0.042	32	0.294
5	0.117	0.098	0.026	24	0.225
6	0.153	0.137	0.038	21	0.246
7	0.021	0.000	0.000	23	0.000
8	0.085	0.048	0.011	30	0.133
9	0.145	0.130	0.040	20	0.274
10	0.158	0.142	0.038	11	0.242
11	0.162	0.142	0.031	18	0.193
12	0.137	0.121	0.034	15	0.248
13	0.153	0.138	0.037	11	0.243
14	0.162	0.141	0.036	18	0.222
15	0.162	0.145	0.035	16	0.214
16	0.066	0.036	0.013	15	0.196
17	0.168	0.152	0.045	18	0.270
18	0.133	0.113	0.036	17	0.273
19	0.021	0.000	0.000	21	0.000
20	0.158	0.144	0.057	40	0.358
21	0.069	0.059	0.021	43	0.309
22	0.128	0.123	0.048	49	0.373
23	0.029	0.006	0.002	42	0.078
24	0.004	0.000	0.000	38	0.000
25	0.006	0.000	0.000	38	0.000
26	0.004	0.000	0.000	31	0.000
27	0.023	0.000	0.000	34	0.000
28	0.173	0.162	0.059	46	0.340
SUM	2.878	2.409	0.727	-	-
AVG	0.103	0.086	0.026	26	0.253
NRSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT STORAGE PERFORMANCE

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053 SOLAR/1039-79/02
REPORT PERIOD: FEBRUARY, 1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
SUM	N.A.	N.A.	N.A.	-	-
AVG	N.A.	N.A.	N.A.	N.A.	N.A.
NBS ID	Q200	Q201	Q202		NICH

* DENOTES UNAVAILABLE DATA.

2. DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT HOT WATER SUBSYSTEM

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053
 REPORT PERIOD: FEBRUARY, 1979
 SOLAR/1039-79/02

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR. OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HCT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.093	19	0.000	NOT	0.090	NOT	0.150	-0.000	0.025	49	141	102
2	0.081	16	0.033	NOT	0.091	NOT	0.152	-0.004	0.025	46	145	120
3	0.124	64	0.032	NOT	0.050	NOT	0.084	-0.005	0.076	49	143	129
4	0.114	53	0.033	NOT	0.045	NOT	0.075	-0.005	0.064	46	138	144
5	0.098	34	0.021	NOT	0.086	NOT	0.143	-0.004	0.053	43	146	112
6	0.030	29	0.031	NOT	0.043	NOT	0.072	-0.005	0.016	44	140	64
7	0.033	21	0.000	NOT	0.047	NOT	0.078	-0.000	0.016	43	147	36
8	0.166	22	0.010	NOT	0.140	NOT	0.233	-0.002	0.052	42	147	187
9	0.054	18	0.034	NOT	0.059	NOT	0.099	-0.005	0.016	42	147	63
10	0.014	13	0.021	NOT	0.049	NOT	0.082	-0.005	0.007	47	135	18
11	0.003	8	0.023	NOT	0.023	NOT	0.038	-0.005	0.003	47	134	4
12	0.064	35	0.028	NOT	0.069	NOT	0.115	-0.004	0.044	42	146	94
13	0.067	27	0.030	NOT	0.074	NOT	0.123	-0.005	0.020	44	150	105
14	0.056	45	0.029	NOT	0.055	NOT	0.091	-0.005	0.038	48	148	70
15	0.004	22	0.026	NOT	0.019	NOT	0.032	-0.002	0.003	47	144	4
16	0.170	36	0.011	NOT	0.128	NOT	0.213	-0.002	0.068	41	146	189
17	0.062	38	0.038	NOT	0.061	NOT	0.101	-0.005	0.033	45	144	79
18	0.109	29	0.030	NOT	0.100	NOT	0.167	-0.004	0.059	41	144	137
19	0.059	25	0.000	NOT	0.070	NOT	0.117	-0.000	0.021	45	138	76
20	0.042	8	0.049	NOT	0.075	NOT	0.125	-0.006	0.011	44	150	139
21	0.095	36	0.018	NOT	0.078	NOT	0.087	-0.003	0.054	43	144	113
22	0.048	24	0.040	NOT	0.052	NOT	0.112	-0.005	0.024	45	140	82
23	0.057	23	0.002	NOT	0.067	NOT	0.077	-0.001	0.027	45	147	64
24	0.042	22	0.000	NOT	0.046	NOT	0.224	0.000	0.014	43	142	47
25	0.128	8	0.000	NOT	0.134	NOT	0.102	0.000	0.015	44	146	141
26	0.044	3	0.000	NOT	0.061	NOT	0.140	0.000	0.006	45	148	51
27	0.072	4	0.000	NOT	0.084	NOT	0.133	0.000	0.006	44	146	83
28	0.079	11	0.052	NOT	0.080	NOT	0.133	-0.006	0.021	42	148	85
SUM	2.004	-	0.600	N.A.	1.977	N.A.	3.295	-0.089	0.830	-	-	2540
AVG	0.072	29	0.021	N.A.	0.071	N.A.	0.118	-0.003	0.030	45	144	91
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
 ? DENOTES NULL DATA.
 N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENVIRONMENTAL SUMMARY

SOLAR/1029-75/02

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02052
REPORT PERIOD: FEBRUARY, 1979

DAY OF MONTH	TOTAL INSULATION BTU/SQ.FT	DIFFUSE INSULATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	478	NOT	23	24	NOT	NOT	NOT
2	1512		22	26			
3	1834		24	30			
4	1822		25	32			
5	1497		19	24			
6	1957		16	21			
7	265		19	23			
8	1096		23	30			
9	1854		13	20			
10	2025		5	11			
11	2075		2	8			
12	1758		5	15			
13	1950		6	11			
14	2080		3	8			
15	2079		12	16			
16	251		12	15			
17	2156		4	8			
18	1701		8	17			
19	269		13	21			
20	2028		26	40			
21	885		37	43			
22	1635		42	49			
23	367		34	42			
24	54		36	38			
25	72		37	38			
26	57		32	31			
27	298		33	34			
28	2212		37	46			
SUM	36903	N.A.	-	-	-	-	-
AVG	1318	N.A.	20	26	N.A.	N.A.	N.A.
NBS IN	0001		N113		N115	N114	

* DENOTES UNAVAILABLE DATA.

2 DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

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